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(54) Method and apparatus for adhesively securing elastic strips under tension to plastics sheet material using hot melt adhesives

(57) According to the invention of elastic material (4) under tension are adhesively secured to the surface of sheet of plastics material (2) for example, polyethylene, using a strip of extruded melt adhesive. Wherein before contact with the backing sheet the under surface of the adhesive strip is cooled and the elastic strip (4) is then pressed into contact with the uncooled upper surface of the adhesive strip such that the elastic is applied to the adhesive under tension. The invention is particularly applicable to the securing of elastic sealing strips onto the backing sheets of sanitary napkins and pads.

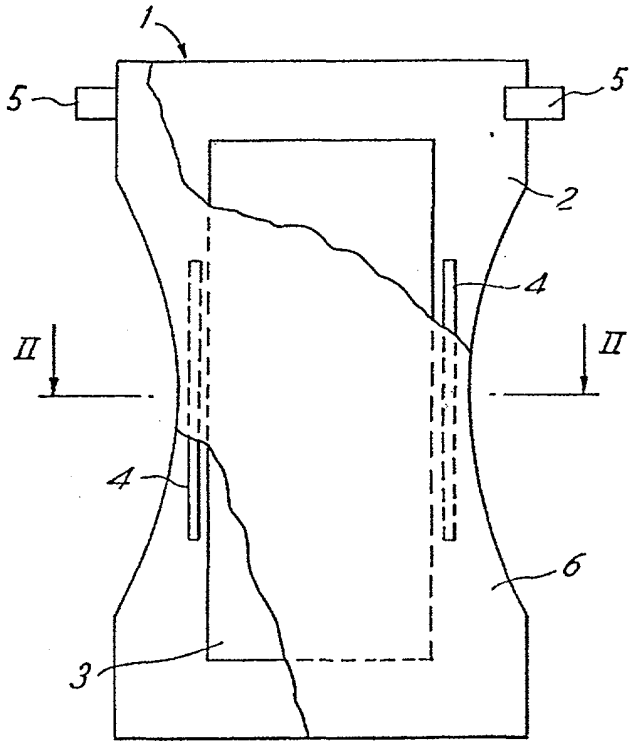

FIG. 1

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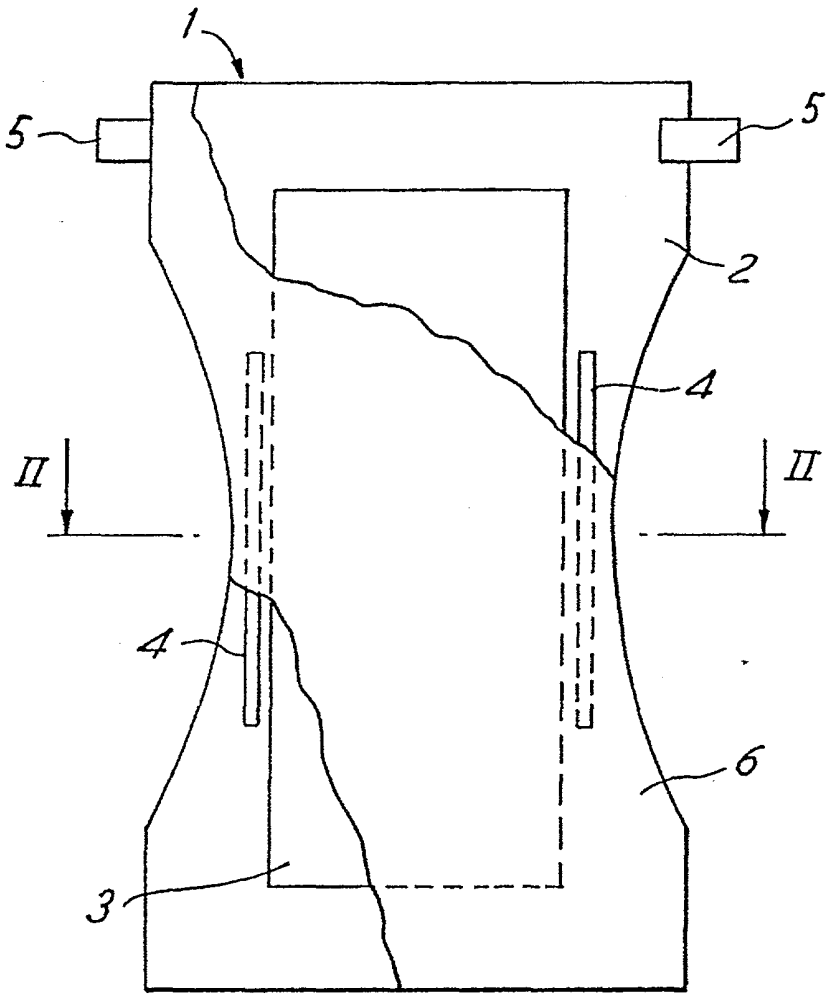


FIG. 1

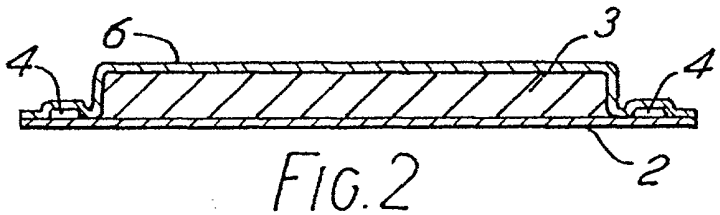
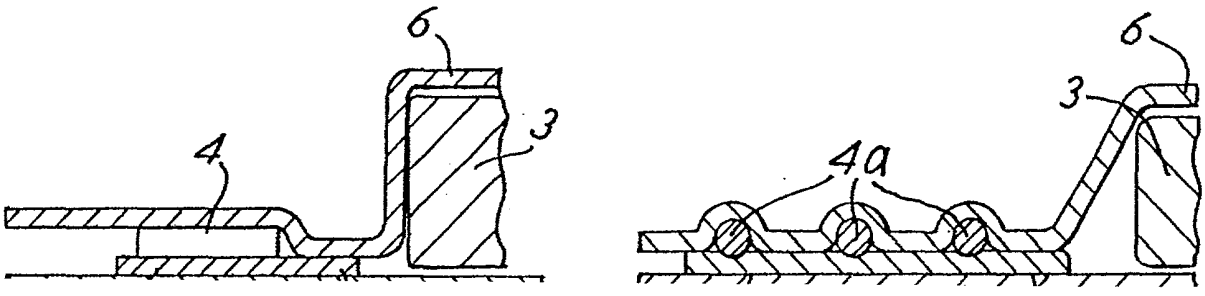


FIG. 2



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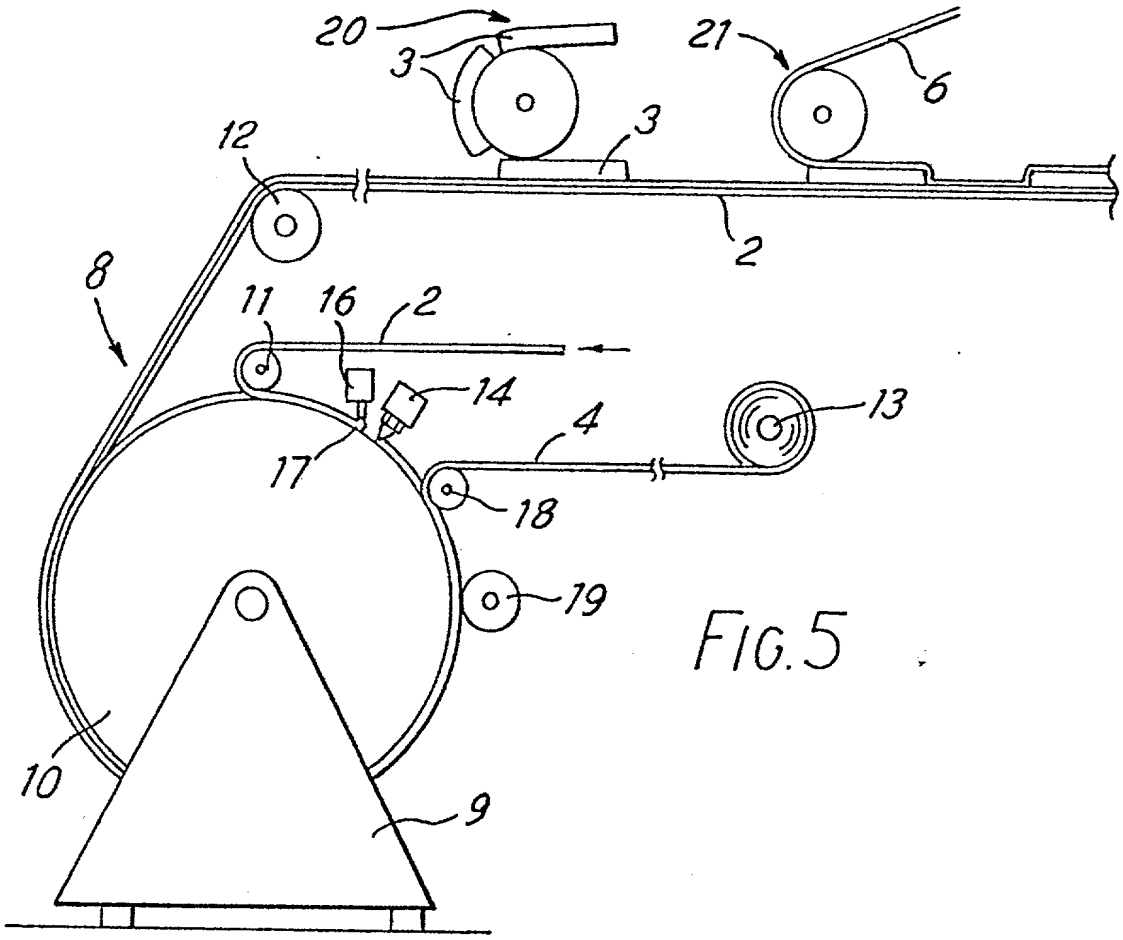

FIG.5

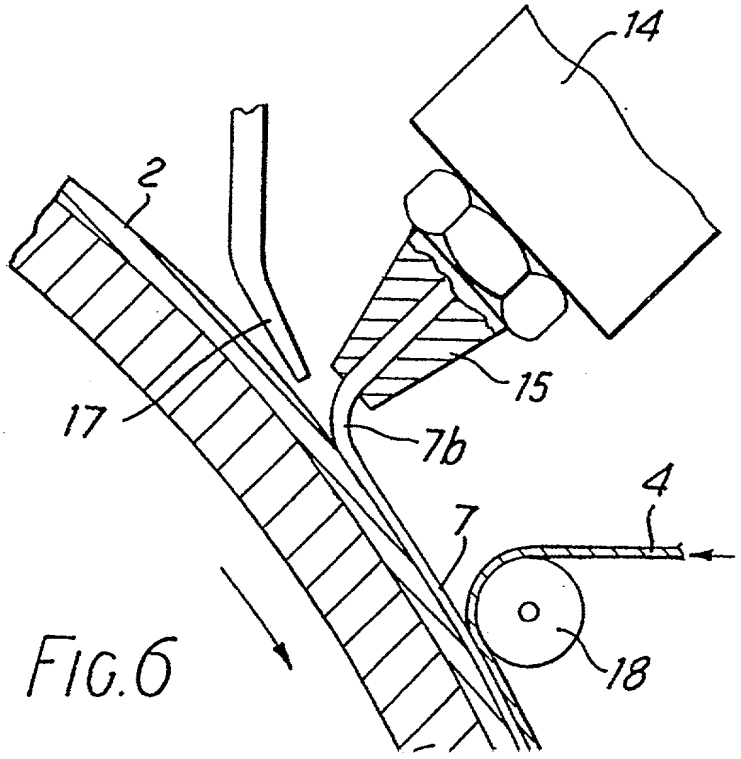

FIG.6

SPECIFICATION

Method and apparatus for adhesively securing elastic strips under tension to plastics sheet material using hot melt adhesives

This invention relates to a method and apparatus for adhesively securing one or more strips of elastic material under tension to the surface of an underlying backing sheet of plastic material.

The invention is particularly applicable to the manufacture of sanitary products, as, for example, disposable baby diapers or adult incontinence pads.

In these products, elastic elements in tension are fixed along the longitudinal edges of a sheet of impermeable plastic material, which constitutes the outer covering of the product, to obtain a better fit of the product on the legs of the user.

Several processes and machines are known to apply elastic elements on disposable diapers and similar products.

For example, U.S. Patent 4,081,301 suggests to stretch uniformly a rubber ribbon, to apply a layer of adhesive on spaced portions of said ribbon, and to make those portions of the ribbon adhere to a sheet of impermeable plastic material that constitutes the outer covering of a disposable diaper.

U.S. Patent 4,360,398 illustrates the use of a rotating drum as a device to carry a sheet of plastic material on which have been applied elastic elements in tension while the adhesive applied on the ribbons themselves is setting.

U.K. Patent 2,107,573 discloses the use of foamed adhesive to overcome heat-damage problems.

The application of the adhesive on the elastic elements of the prior art has been found in actual practice to create considerable inconveniences.

First of all the application of the adhesive to the elastic element (which is in tension) is realized by means of a coating nozzle that makes contact with the elastic element, often causing the said elastic element to break. Another considerable inconvenience is created because of the ease with which the elastic element tends to turn over. When this happens, the face which contacts the sheet of impermeable plastic material is not coated with adhesive. In this case, not only does the elastic element not adhere to the sheet of plastic material, but also the adhesive on the wrong side can dirty the product and the machine and cause a stoppage of the equipment used to fix the elastic elements to the sheet of plastic material.

Another inconvenience created by the application of the adhesive to an element under tension is the difficulty to obtain a uniform distribution and a precise location of the adhesive because of the relative ease with which the elastic element (which is mechanically stretched before the applying of the substantial state of tension. However, one would not normally think of applying the adhesive to the sheet of plastic material because, to obtain a steady setting of the adhesive under controlled conditions to allow high rates of production, it is necessary to use hot melt glues. These are adhesives which are at the fluid state at temperatures within 120 degrees and 180 degrees and the direct application of these adhesives to a sheet of thin plastic material (e.g. a film of polythene having a thickness of 20-30 micron) causes the formation of waves, wrinkles, bubbles and holes and the consequent impossibility to use said sheet for the intended purposes.

Prior inventors have suggested processes and means to solve the problem with the use of foamed adhesive, but such apparatus and methods have been complicated and difficult to operate.

The present invention seeks to provide a method and apparatus that does not present the previously described inconveniences, and one which is easily and economically realizable.

In one aspect this invention provides a method of adhesively securing one or more strips of elastic material under tension to the surface of an underlying backing sheet of plastics material which comprises extruding a strip of molten hot melt adhesive from a nozzle, applying a cooling medium to one face of the extruded adhesive strip thereby to provide a temperature differential between the two opposite faces of the strip, advancing the backing sheet relative to the nozzle thereby to lay said strip cool side down onto the backing sheet, laying the strip of elastic material under tension longitudinally onto the exposed, uncooled surface of the strip of adhesive, and pressing the tensioned elastic strip into contact with adhesive along the length of the strip.

More specifically the method of this invention includes:

- mounting adhesive-applying devices in front of a moving sheet of plastic material,
- producing relative movement between said applying devices and said sheet,
- ejecting the adhesive from said applying devices in such a manner that the adhesive deposits in a strip on the sheet while a continuous mass of melted adhesive extends obliquely between the applying devices and the strip of adhesive already deposited on the sheet,
- producing an aeriform flow of cool gas that hits the side of said continuous mass of adhesive facing the sheet,
- applying the ribbon-like elastic element on the other side of the adhesive strip after it has been deposited on the sheet of plastic material.

This method allows the adhesive to adhere to the sheet of plastic material without the previously-described inconveniences. The adhesive is applied to the sheet after that the side of the adhesive strip

larly when the adhesive has been applied like a strip of spaced dashes. The aeriform flow of cool gases also produces an effect of aerodynamic support of the continuous mass of adhesive in melt state which comes out of the applying devices, allowing a more accurate formation of the adhesive dashes.

Furthermore, the adhesive can be applied to the sheet of plastic material as a strip whose width is equal to or wider than the width of the elastic element. The adhesive sticking to the sheet of plastic material ensures that the elastic element will be received over its entire width. This result cannot generally be obtained by applying the adhesive to the elastic element, because the application of the adhesive to the whole surface of the elastic element would cause an overflow of the adhesive, consequently causing the applying devices to become dirty and fouled with the adhesive.

The present invention also provides an opportunity to select an adhesive strip wide enough to accommodate two or more elastic bands (as in the manufacture of elastic-leg diapers). Such diapers also include an absorbent element of lengthened shape, placed between the above-mentioned ribbon-like elastic elements, and covered by a sheet of material permeable to liquids, applied on said face of the sheet of plastic material. In such application, the process according to the invention is characterized by the utilization of applying devices susceptible of depositing on the sheet of plastic material strips of adhesive wider than the ribbon-like elastic elements, so that, after the application of the elastic elements, the covering sheet, permeable to liquids, is secured by the adhesive which extends along the sides of the elastic elements themselves.

In a second aspect this invention provides an apparatus for carrying out the above method and comprising a nozzle and means for extruding a molten strip of adhesive from said nozzle, means for positively cooling one side of said extruded strip of adhesive, means for supporting the backing sheet and advancing the backing sheet relative to the nozzle, whereby said nozzle deposits said extruded strip, cooled side down onto the backing sheet, means for tensioning the elastic strip or strips and means for depositing the elastic strip or strips under tension longitudinally onto the exposed uncooled side of the adhesive strip.

In a specific embodiment, the apparatus includes:

– a rotating drum, temporarily supporting, on its outer surface, the part of the sheet of plastic material which will receive the elastic element.

– devices (for applying hotmelt adhesive in its melted state) disposed in front of that part of the sheet which is supported on the surface of the drum in such a manner that the adhesive is placed strip-like on the sheet while a continuous mass of melted adhesive extends obliquely between the of said continuous mass facing the sheet of plastic material, and

– applying-devices for said ribbon-like element, placed after said applying-devices of adhesive (in the direction relative to the advancement of the sheet of plastic material) and capable of applying the ribbon-like element intension on the strip of adhesive deposited on the sheet of plastic material itself.

For the purpose of illustrating the invention, there is shown in the accompanying drawings a form thereof which is at present preferred, although it is to be understood that the several instrumentalities of which the invention consists can be variously arranged and organized and that the invention is not limited to the precise arrangements and organizations of the instrumentalities as herein shown and described.

In the drawings, wherein like reference characters indicate like parts:

Figure 1 schematically shows a disposable baby diaper or an adult incontinence pad susceptible of being produced according to the process and the equipment of the invention.

Figure 2 is a section along line II-II of Figure 1.

Figure 3 shows, in a larger scale, a more detailed view the left part of Figure 2.

Figure 4 shows a modification of Figure 3.

Figure 5 is a view inside elevation schematically showing equipment for practicing the present invention.

Figure 6 is a greatly enlarged view of the adhesive application shown in Figure 5.

In the Figures, the numeral 1 indicates a disposable baby diaper or an adult incontinence pad.

The diaper 1 is essentially formed by a rectangular sheet 2 of impermeable plastic material (for instance a film of polythene having a thickness of 25-30 microns) on which an absorbent matt 2 is applied. This may be rectangular in shape and made of cellulose pulp, defibrated by a dry system, or similar absorbent material.

Elastic ribbon-like elements 4 are secured to the sheet 2 along the major edges of the absorbent matt 3. The absorbent matt 3 can have shapes different from the rectangular one represented in Figure 1, for instance an anatomical shape where the ends are wider than the central zone.

The major sides of the impermeable sheet 2 are preferably cut away along a curve to produce a "contoured" diaper. These portions along the curves encircle the legs of the users. The elastic elements 4 are applied on the impermeable sheet 2 in a state of tension. When they contact, they cause the diaper to form a pouch or pocket to receive and direct the body fluids to the absorbent matt 3. They also cause the diaper to fit tightly around the legs of the user and prevent leakage of body fluids.

The diaper is fastened around the user's waist, connecting the minor sides of the impermeable

The covering sheet 6, which will be in contact with the user's skin, is preferably a soft, nonwoven material to minimize irritation of the user's skin.

Figure 3 shows a strip of hotmelt adhesive 7 securing the elastic element 4 on the impermeable sheet 2. In the adhesive strip 7 a lateral part 7a extends beyond a side of the elastic element 4 towards the inner part of the diaper. Such lateral part adhesively connects the covering sheet 6 to the impermeable sheet 2, securing an effective action of lateral stabilization of the absorbent matt 3.

In the embodiment shown in Figure 4, instead of a single ribbon-like elastic element 4, there are three thread-like elastic members 4a connected to the impermeable sheet 2 by the adhesive strip 7. The elastic members 4a operate substantially the same as the single ribbon-like element 4.

In the present description and in the following claims, the words "elastic ribbon-like element" must therefore be interpreted as referring I in general I to all varieties and shapes of elastic, including the multi-strand structure in Figure 4. The choice of elastic depends on how much tension is desired, after the application on the impermeable sheet 2, to obtain a better adherence on the sides of the diaper 1 around the user's legs.

Figures 5 and 6 illustrate an apparatus 8 used in the production of the diaper 1 shown in Figures 1 to 4.

In such equipment, frame members 9 support a metal drum 10 so as to rotate around a horizontal axis. The drum 10 is rotated in a clockwise direction in Figures 5 and 6 by a motor (not visible in the Figures) disposed between the frame members 9. Two turning rolls 11 and 12 guide a continuous sheet of impermeable plastic material (which forms the sheet of outer covering 2 of the diaper 1). The rolls 11 and 12 are supported in such a way that the continuous sheet of plastic material travels around roll 11 into contact with the outer surface of the rotating drum 10. The sheet of plastic material is then removed from surface of the the drum 10 around the roll 12.

Two feeders 13 (only one is visible in the Figure) supply a continuous ribbon of elastic material to be applied to the sheet of plastic material as elastic elements like the ones shown at 4 in Figure 1.

For clarity, the continuous sheet winding around roll 11, and the elastic ribbon supplied by the feeder 13, are shown in Figures 5 and 6 by references 2 and 4, the same references are used in Figures 1 to 4, to indicate the sheet of outer covering and the two elastic elements which feed onto the sheet parallel to each other and on opposite sides of the matt 3.

Figures 5 and 6 (and the remaining parts of this description) describe only one of the two devices which apply adhesive to the elastic elements, but it is clear that a similar device is provided for the application of the other elastic ribbon 4, which is not shown by the reference number 7.

The hotmelt adhesive leaves the nozzle 15 at a temperature between 120 degrees and 180 degrees C. Therefore, between the nozzle 15 and the portion of strip 7 already deposited on sheet 2, carried around by drum 10, a continuous mass of melted adhesive 7b obliquely extends. Cooling air, provided by a generator 16 and a second nozzle 17, is directed in an approximately tangential way against the outer surface of the plastic web 2 on the drum 10.

The relative disposition of the applying device of adhesive 14 and of the generator of cooling air 16 is such that the flux of air coming out from nozzle 17 hits the side of the mass of adhesive 7b which faces the sheet of plastic material 2. Generator 16 includes a thermostatically controlled cooling device (not visible in the Figure) to keep the temperature of the air coming out from nozzle 17 within −3 degrees and +20 degrees C. A preferred range of temperature is between +2 and 15 degrees C.

The air discharged by nozzle 17 also carried out a cooling action of the face of the adhesive mass 7b which will contact sheet 2. The cooling action of the adhesive carried out by generator 16 is designed to allow the application of the adhesive to the surface of sheet 2.

Without my invention, this could not be carried out without extensively modifying the adhesive or without damaging the sheet 2. In the prior devices, the adhesive temperature is too high for the thin sheet of polythene 2, and it causes deformations, wrinkles, formation of bubbles and holes and the consequent impossibility to use the sheet itself. In the equipment of Figures 5 and 6, such problems are avoided as the adhesive is at least partially and selectively cooled before being applied on the surface of sheet 2.

The cooling of only the face assigned to directly contact sheet 2 allows the reduction of the adhesive's temperature in order to avoid any damaging of sheet 2, keeping, at the same time, the necessary characteristics of setting of the adhesive both on the sheet 2 and on the elastic ribbon 4. The temperature of the cooling air is chosen, according to the discharge temperature of the adhesive, in correspondence to the minimum value with which the strip of adhesive 7 deposited on sheet 2 maintains the necessary characteristics of adhesivity. Considering the present state of the art of hotmelt adhesives, a preferred temperature of the cooling air is between 7-10 degrees C. Such result is more easily attainable applying the elastic ribbon 4 on the adhesive strip 7 in a region immediately following the nozzle 15 in the direction relative of advancement of sheet 2.

The application of the elastic ribbon 4 is carried out by means of a roll 18 whose axis of rotation is parallel to the axis of drum 10 but whose surface is not in contact with the drum-surface.

Typically, the linear speed of applying of ribbon 4 is chosen at about half the peripheral speed of sheet 2 and drum 10.

Roll 18 is moreover movable along its axis of rotation to provide a precise positioning of ribbon 4 onto adhesive strip 7.

In this way, one can avoid disalignment which could cause an imperfect adhesive contact between ribbon 4 and the sheet 2.

In case the adhesive strip 7 is wider than the elastic ribbon, the action of guidance carried out by roll 18 allows the accurate positioning of ribbon 4 on the strip 7 assuring the presence, on at least one side of ribbon 4 itself, of the residual adhesive strip 7a as shown in Figures 3 and 4.

The flow of air coming out from nozzle 17, besides cooling the adhesive coming out from nozzle 25, provides pneumatic support for the mass of melt adhesive 7b. Such support, which assures a fixed orientation of mass 7b, is particularly advantageous when the adhesive strip 7 is applied as discrete lengths which secure the elastic ribbon only on the central portion of the sheet of impermeable covering of the diaper, as shown in Figure 1. In such conditions, it is possible to interrupt periodically the discharge of adhesive from nozzle 25 without the adhesive dripping onto the sheet 2 where it is not wanted or needed.

In Figure 5, 19 shows a pressure roll below roll 18 (in the direction of advancement of sheet 2) which presses ribbon 4 against the surface of drum 10 to set the ribbon firmly on sheet 2 while hot-melt adhesive cools and sticks.

The surface of roll 19 is preferably covered with a non-sticking substance, for instance, silicone rubber.

At 20 and 21, I schematically show two additional working stations of the equipment 8.

Particularly, 20 shows a station where, on the face of sheet 2 on which the elastic elements 4 have been applied, absorbent matts similar to the one shown as 3 in Figures 1 and 4, (or differently shaped) are applied at spaced locations. No. 21 shows a station where, on the impermeable sheet 2, I apply a sheet of nonwoven covering (shown as 6 in Figures 1 to 4) which not only contacts the user's skin but also holds the absorbent matt 3 in place. Preferably, the connection of sheet 6 to sheet 2, is effected by using the residual adhesive 7A (Figures 3 and 4) on the sides of elastic ribbons 4.

In successive working stations, not visible in the Figures, the impermeable sheet 2, on which elastic ribbons 4, the absorbent matt 3, and the covering sheet 6 have been applied, is cut out along the edges and is provided with the adhesive tape-tabs 5. The continual web of assembled materials is then divided into sections in successive steps, each forming a complete diaper as the one shown in Figure 2.

It is to be understood that the present invention illustrative, and therefore not restrictive, reference being made to the appended claims rather than to the foregoing description to indicate the scope of the invention.

CLAIMS

1. A method of adhesively securing one or more strips of elastic material under tension to the surface of an underlying backing sheet of plastics material which comprises extruding a strip of molten hot melt adhesive from a nozzle, applying a cooling medium to one face of the extruded adhesive strip thereby to provide a temperature differential between the two opposite faces of the strip, advancing the backing sheet relative to the nozzle thereby to lay said strip cool side down onto the backing sheet, laying the strip of elastic material under tension longitudinally onto the exposed, uncooled surface of the strip of adhesive, and pressing the tensioned elastic strip into contact with adhesive along the length of the strip.

2. A method according to claim 1, wherein the cooling medium comprises a jet of cooling gas directed onto said one face of the extruded adhesive strip.

3. A method according to claim 2, wherein the cooling medium is a jet of cold air.

4. A method according to any one of claims 1-3, wherein the hot melt adhesive is extruded at a temperature in the range 120-180°C and the cooling medium has a temperature in the range −3 to +20°C.

5. A method according to claim 4, wherein the cooling medium has a temperature in the range +2 to +15°C.

6. A method according to claim 4, wherein the cooling medium has a temperature in the range +7 to +10°C.

7. A method according to any one claims 1-6, wherein the adhesive strip is extruded downwardly from a stationary nozzle onto the surface of the backing sheet as it is carried past the nozzle on the surface of a rotating drum being driven about a horizontal axis.

8. A method according to claim 7, wherein the elastic strip or strips is or are laid onto the adhesive strip downstream from the said nozzle and whilst the backing sheet is still supported by the drum, and wherein the speed of travel of the backing sheet on said drum is greater than the speed at which the elastic strip is fed onto the adhesive, thereby to effect the tensioning of the elastic strip as it is placed into contact with said adhesive.

9. A method according to any one of the preceding claims wherein the backing sheet is a sheet of non-porous plastics material, to which two elastic strips are applied in spaced apart parallel relation, and wherein there is placed between the two elastic strips a pad of absorbent material covered and held in place by cover sheet of porous mate-

sheet is greater than the width of the elastic strip or strips bonded thereto, the excess width of adhesive thereby serving to secure the said cover sheet to the backing sheet along the edges of the absorbent pad.

11. A method according to any one of claims 1-10, wherein the backing sheet is of polyethylene.

12. A method according to claim 1, substantially as hereinbefore described with reference to the accompanying drawings.

13. Apparatus for carrying out the method of claim 1, comprising a nozzle and means for extruding a molten strip of adhesive from said nozzle, means for positively cooling one side of said extruded strip of adhesive, means for supporting the backing sheet and advancing the backing sheet relative to the nozzle, whereby said nozzle deposits said extruded strip, cooled side down onto the backing sheet, means for tensioning the elastic strip or strips and means for depositing the elastic strip or strips under tension longitudinally onto the exposed uncooled side of the adhesive strip.

14. Apparatus according to claim 13, wherein the cooling means comprise a second nozzle positioned adjacent said first nozzle and means to feed a jet of cooling fluid onto a surface of the adhesive strip as it is extruded from said first nozzle.

15. Apparatus according to claim 14, wherein said cooling means is a cold air jet.

16. Apparatus according to claim 13, 14 or 15, wherein the means for supporting and advancing the backing sheet relative to the adhesive extrusion nozzle comprise a drum mounted for rotation about a horizontal axis below a fixed, downwardly directed adhesive extrusion nozzle and means for feeding the backing sheet onto the surface of the drum as it is driven past the nozzle.

17. Apparatus according to claim 16, comprising a pressure roll mounted downstream of the adhesive extrusion nozzle and engaging against the surface of said drum, and means for feeding the elastic strip or strips into the nip between said pressure roll and said drum, whereby said pressure roll presses the elastic strip or strips longitudinally into the strip of adhesive applied by said extrusion nozzle, said feed means being operable to feed the elastic strip or strips into said nip at a slower linear speed than the peripheral velocity of said drum.

18. Apparatus according to claim 13, substantially as hereinbefore described with reference to Figures 5 and 6 of the accompanying drawings.

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